CLAIMS:

1. An autothermal reactor for the generation of a hydrogen-containing product gas stream from a feed gas stream, the autothermal reactor comprising:

a reactor vessel having a feed gas stream inlet end and a product gas outlet end;

a partial oxidation catalyst located within the reactor vessel and positioned in the path of the feed gas stream;

a steam methane reforming catalyst located within the reactor vessel and positioned downstream from the partial oxidation catalyst in the path of the feed-gas stream;

a first inlet means to introduce a first feed gas stream component selected from the feed gas component stream group comprising a hydrocarbon fuel, oxidant, and steam, the first inlet means located at the fuel gas stream inlet end of the reactor vessel; and

means to pulsate associated with the first inlet means to pulsate the flow of the first feed gas stream component into the autothermal reactor.

2. The autothermal reactor of claim 1 further comprising a second inlet means to introduce a second feed gas stream component selected from the feed gas component stream group comprising a

hydrocarbon fuel, oxidant, and steam, the second feed gas stream component being different from the first feed gas stream component, the second inlet means being located at the fuel gas stream inlet end of the reactor vessel.

3. The autothermal reactor of claim 2 further comprising a third inlet means to introduce a third feed gas stream component selected from the feed gas component stream group comprising a hydrocarbon fuel, oxidant, and steam, the third feed gas stream component being different from the first feed gas stream component and the second feed gas stream component, the third inlet means being located at the fuel gas stream inlet end of the reactor vessel.

4. The autothermal reactor of claim 3 wherein the first feed gas stream component is a hydrocarbon fuel, the second feed gas stream component is oxidant, and the third feed gas stream component is steam.

5. The autothermal reactor of claim 3 wherein the first feed gas stream component is oxidant, the second feed gas stream component is hydrocarbon fuel, and the third feed gas stream component is steam.

6. The autothermal reactor of claim 1 wherein the reactor vessel includes a mixing zone for the mixing of the feed gas component stream, the mixing zone being located upstream of the partial oxidation catalyst.

7. The autothermal reactor of claim 6 wherein the mixing zone consists of a series of non-catalyzed monolith slices spaced apart, such that the resonance time within the slice-space combination is from 50% to 200% of the cycle time of the pulsing.

8. The autothermal reactor of claim 1 wherein the partial oxidation catalyst is selected from the group consisting of a nickel-based catalyst, a precious metal-based catalyst, and a precious metal-based catalyst with a metal-oxide promoter.

9. The autothermal reactor of claim 1 wherein the partial oxidation catalyst is configured as pellets.

10. The autothermal reactor of claim 1 wherein the partial oxidation catalyst is configured as monoliths.

11. The autothermal reactor of claim 1 wherein the steam methane reforming catalyst is a metal-oxide-based catalyst.

12. The autothermal reactor of claim 1 wherein the means to pulsate first feed gas stream component flow is a flow control element.

13. The autothermal reactor of claim 12 wherein the flow control element is an actuator operated flow control valve whose actuator is cyclically driven between two predetermined positions by a pre-programmed control logic.

14. The autothermal reactor of claim 12 wherein the flow control element is an actuator operated flow control valve whose actuator is cyclically driven between two predetermined positions by a mechanically linked feed-back system which throttles or opens the flow-control valve in inverse relationship to the pressure.

15. The autothermal reactor of claim 12 wherein the flow control element is an feedback loop based flow-control valve whose actuator is cyclically driven between two predetermined positions by incorporating a zero-dampening factor in its feed-back control system.

16. The autothermal reactor of claim 1 wherein the means to pulsate the first feed-gas stream component flow is a rotating gas

compressor whose operation develops pulsed flow characteristics.

17. The autothermal reactor of claim 1 wherein the means to pulsate first feed-gas stream component flow is a peristaltic flow movement device.

18. The autothermal reactor of claim 1 further comprising downstream components to further process the gases; and said downstream components are designed to propagate the pulsed flow characteristics developed in the ATR into the fuel cell to enhance CO tolerance of the fuel cell.

19. The autothermal reactor of claim 1 further comprising downstream components to further process the gases; and said downstream components are designed to dampen pulsed flow characteristics developed in the ATR such that it does not propagate into the fuel cell.

20. A method of generating a hydrogen-containing product gas from an autothermal reactor containing a partial oxidation catalyst and a steam methane reforming catalyst, the method comprising the steps of:

pulsatingly introducing a feed gas mixture comprising a first

feed gas stream component selected from the feed gas component group comprising a hydrocarbon fuel, oxidant, and steam into the autothermal reactor;

passing the feed gas mixture over the partial oxidation catalyst to produce a partially oxidized product gas stream;

passing the feed gas mixture over the steam methane reforming catalyst to generate the hydrogen-containing product gas stream; and

removing the hydrogen-containing product gas stream generated from the autothermal reactor.

21. The method as claimed in claim 20 further comprising introducing into the autothermal reactor a second feed gas stream component selected from the group comprising a hydrocarbon fuel, oxidant, and steam, the second feed gas stream component being different from the first feed gas stream component, and mixing the first and second feed gas stream components to produce the feed gas mixture.

22. The method as claimed in claim 21 further comprising introducing into the autothermal reactor a third feed gas stream component selected from the group comprising a hydrocarbon fuel, oxidant, and steam, the third feed gas stream component being

different from the first feed gas stream component and the second feed gas stream component; and mixing the first, second and third feed gas stream components to produce the feed gas mixture.

23. The method as claimed in claim 22 wherein the first feed gas stream component is a hydrocarbon fuel, the second feed gas stream component is an oxidant and the third feed gas stream component is steam.

24. The method as claimed in claim 22 wherein the first feed gas stream component is oxidant, the second feed gas stream component is a hydrocarbon fuel, and the third feed gas stream component is steam.

25. The method as claimed in claim 20 wherein the partial oxidation catalyst is selected from the group consisting of a nickel-based catalyst, a precious metal-based catalyst, and a precious metal-based catalyst with a metal-oxide promoter.

26. The method as claimed in claim 20 wherein the partial oxidation catalyst is configured as pellets.

27. The method as claimed in claim 20 wherein the partial

oxidation catalyst is configured as monoliths.

28. The method as claimed in claim 20 wherein the pulsating introduction of the first feed-gas stream component flow is created by a flow control element.

29. The method as claimed in claim 28 wherein the pulsating introduction creates a peristaltic flow movement.